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# PHILOSOPHICAL TRANSACTIONS.

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I. *The Croonian Lecture. On the Structure and Uses of the Membrana Tympani of the Ear. By Everard Home, Esq. F. R. S.*

Read November 7, 1799.

THE subject of inquiry appointed by the Croonian Institution, has been greatly elucidated at different times by ingenious members of this learned Society. A large field, however, still remains open ; and, respecting future investigations, I shall have occasion to offer a fresh proof of the aid to be derived from comparative anatomy, in ascertaining the structure of parts which, from their minuteness and situation in the human body, admit with much difficulty of being explored.

The principal object of the present lecture is to communicate a discovery of the structure of the membrana tympani ; which, in some respects, affords a new and very curious instance of the application of muscular action, and may conduce to account for certain phænomena in the sense of hearing, in a more satisfactory manner than has hitherto been proposed.

The membrana tympani has always been considered as a

common membrane, which, by means of muscles belonging to the malleus being stretched or relaxed, became fitted, in its various degrees of tension, to convey the vast variety of external sounds to the internal organ. Its shape, situation, and office, have procured it the name of drum of the ear; and the muscles of the malleus having been deemed sufficient for bracing and unbracing it, less attention was bestowed on the structure of the membrane itself: to which may be added, that in the human ear, and generally in the ear of quadrupeds, the membrane is so extremely small and thin, and in its situation so peculiarly confined, as not to be got at for inspection but with much difficulty.

The case is different in the elephant, where this membrane is so very large, that the parts of which it is composed are readily distinguished: they are even conspicuous to the naked eye; and muscular fibres are seen passing along the membrane, in a radiated manner, from the bony rim which surrounds it, towards the handle of the malleus, to which the central part of the membrane is firmly attached.

This discovery in the elephant having led to that of a similar construction in the human *membrana tympani*, it may not be improper to relate the circumstances by which I became engaged in the investigation of the organ of hearing in that animal.

Three different opportunities have occurred of dissecting the elephant in London, by the deaths of those which had been presented to his Majesty, and were kept at the King's stables at Pimlico. One of them was given to the late Dr. HUNTER; one to his brother Mr. J. HUNTER; and the third to Sir ASHTON LEVER.

From my being connected with Mr. JOHN HUNTER's pursuits in comparative anatomy, I was employed throughout the whole of these dissections, and became extremely desirous of examining the internal parts of the ear, the structure of that organ in the human body having at a very early period particularly engaged my attention ;\* but neither Dr. HUNTER nor his brother could be prevailed upon to sacrifice so large a portion of the skull as was necessary for the purpose.

When Mr. CORSE arrived from Bengal, last year, and mentioned his having brought over a number of skulls of elephants, in order to show the progress of the formation of their grinding teeth,† the desire to examine the organ of hearing in that animal recurred to me so strongly, that I requested to have one of the skulls for that purpose, and Mr. CORSE very readily and obligingly complied with my request.

After having examined the organ in the dried skull, the want of the membrana tympani, and of the small bones, made the information thus received of a very unsatisfactory nature, and increased the desire of seeing these parts in the recent head. In considering how this could be done, I recollected a mutilated elephant's head, preserved in spirits, which had been sent to

\* In the year 1776, I injected the cochlea and semicircular canals of the human ear with a composition of wax and rosin. This was done by placing the temporal bone in the receiver of an air pump, the upper part of which was in the form of a funnel, rendered air-tight by a cork being fitted into its neck, and surrounded with bees' wax. After the air had been exhausted, the hot injection, poured into the funnel, melted the wax, and the cork was pulled out by means of a string previously attached to it ; the injection immediately rushed into the receiver, and was forced, by the pressure of the atmosphere, into the cavities of the temporal bone.

† On this subject, a very ingenious paper has been since published by him, in the Philosophical Transactions for the year 1799.

Mr. HUNTER, but, from the multiplicity of his engagements, had remained neglected in the cask at the time of his death, and in the following year was dried, to show the proboscis, that it might not be altogether spoiled.

Upon examining this dried head, the bones had been so much broken, that one of the organs of hearing was altogether wanting: the other, however, was fortunately entire; and the membrana tympani and small bones, having been little disturbed in the drying of the parts, remained nearly in their natural situation.

The membrana tympani, and every other part of the organ, were found to be much larger in proportion than in other quadrupeds, or in man; differing in this respect from the eye of the elephant, which is unusually small, when compared with the enormous bulk of the animal.

The membrane was found of an oval form; the short diameter of the oval rather more than an inch in length; the long diameter an inch and  $\frac{7}{10}$ ths.

In the human ear, the membrana tympani is nearly circular; the longest diameter is  $\frac{8}{10}$ ths of an inch; the shortest  $\frac{7}{10}$ ths.

As the membrane in the elephant exceeds that of the human ear in thickness as much as in extent, which is as the squares of their diameters, or in the proportion of 135 to 14, it is natural to conclude that the muscular fibres which are to stretch the one, must greatly exceed in strength those capable of producing the same degree of tension in the other.

From this statement, the muscular structure in the human membrana tympani will necessarily be so much less distinct than in the elephant, as scarcely to be visible to the naked eye, and will easily be overlooked by the most attentive observer, who is not directed by some previous information to examine

it under the most favourable circumstances; but, when these are attended to, it can be perceived without the aid of glasses.

If the membrana tympani of the human ear is completely exposed on both sides, by removing the contiguous parts, and the cuticular covering is carefully washed off from its external surface, then, by placing it in a clear light, the radiated direction of its fibres may be easily detected. If a common magnifying glass is used, they are rendered nearly as distinct as those of the elephant appear to the naked eye; their course is exactly the same; and they differ in nothing but in being formed upon a smaller scale.

When viewed in a microscope magnifying 23 times, the muscular fibres are beautifully conspicuous, and appear uniformly the same throughout the whole surface, there being no central tendons, as in the diaphragm; the muscular fibres appear only to form the internal layer of the membrane, and are most distinctly seen when viewed on that side.

In examining this membrane in different subjects, the parts were frequently found in a more or less morbid state. In one instance, the membrane was found loaded with blood-vessels, was less transparent than usual, and was united by close adhesion to the point of the long process of the incus. In another instance, there was a preternatural ossification adhering to it, at a small distance from the end of the handle of the malleus.

As muscles in general are supplied with blood-vessels in proportion to the frequency of their action, it is an object of importance to determine the vascularity of the membrana tympani. Upon this subject, my own want of information has been amply supplied by Dr. BAILLIE, who, in a communication upon this subject, showed me a preparation of the membrane, in which

the vessels had been most successfully injected with coloured wax.

In this preparation, the most beautiful of the kind I ever saw, the vessels in their distribution resembled those of the iris, and were nearly half as numerous: they anastomosed with one another in a similar manner, and their general direction was from the circumference to the handle of the malleus; from near this handle, a small trunk sent off branches, in a radiated manner, which anastomosed with those which had an opposite course.

This correspondence, in the number and distribution of blood-vessels, between the membrana tympani and the iris, is a strong circumstance in confirmation of that membrane being endowed with muscular action.

In the horse, the membrana tympani is smaller than in man; its long diameter is  $\frac{8}{20}$ ths of an inch; the short one  $\frac{6}{20}$ ths; and it is almost quite flat, while in man it is concave, which makes the difference of extent considerably exceed the difference in the diameters. In the horse, the fibrous structure is not visible to the naked eye; it is even indistinctly seen when viewed through a common magnifying glass; but in a microscope it is very visible, and in every other respect agrees in structure with the membrane in the human ear, and in that of the elephant.

In birds, the membrana tympani is larger in proportion than in the quadruped, and more circular in its shape.

In the goose, it is  $\frac{6}{20}$ ths of an inch in its longest diameter, and  $\frac{5}{20}$ ths in its shortest diameter. In the turkey,  $\frac{7}{20}$ ths by  $\frac{5}{20}$ ths. It is thinner in its coats in birds than in the horse, and to the naked eye has no appearance of fibres; but, when viewed in a microscope, there is a visible radiated structure, not very unlike the wire marks upon common writing paper.

In a former Lecture upon the Structure of Muscles,\* in which a comprehensive view was taken of the subject, it was stated, that the organization necessary for muscular contraction could exist in an apparent membrane, and that a fasciculated structure was only necessary when muscular action was to be enabled to overcome resistance. The coats of the *Tænia hydatigena* were mentioned as an instance of the first; and the human heart as the most complex of the second. In comparing the *membranæ tympani* of different animals, they afford a beautiful illustration of the truth of this position.

In birds, where from the smallness of its size the resistance is very trifling, the membrane is very similar to the coat of an hydatid, only still thinner. In the elephant, fibres forming fasciculi are very distinct. The membrane of the horse, and that of the human ear, form the intermediate gradations.

The knowledge of a muscular structure in the *membrana tympani*, enables us to explain many phænomena in hearing, which have not hitherto been accounted for in a satisfactory manner. It is principally by means of this muscle that accurate perceptions of sound are communicated to the internal organ, and that the *membrana tympani* is enabled to vary the state of its tension, so as to receive them in the quick succession in which they are conveyed to it.

In the human ear, and in that of birds, the radiated fibres of the *membrana tympani* have their principal attachment to the extremity of the handle of the malleus, which is nearly in the centre of the membrane.

In the membrane of the elephant, which is oval, the attachment to the handle of the malleus is at some distance from the

\* Philosophical Transactions for the year 1795.

centre. In the horse, deer, and cat, which have the membrane still more oval than the elephant, the handle of the malleus is situated in the long axis of the membrane, with its extremity extending beyond the centre, reaching nearer to the circumference; and the fibres of the radiated muscle are not only attached to its end, but also laterally to nearly the whole length of its handle.

This oval form of the *membrana tympani*, in those quadrupeds, and the very extensive attachment of the fibres of the radiated muscle to the handle of the malleus, may be the reason why their ears are not equally fitted to hear inarticulate sounds, as the ears of birds and of man.

Should this radiated muscle of the *membrana tympani* (which is probably the smallest in the body that has a distinct action) be thought too insignificant to have an office of so much consequence assigned to it, let it be remembered, that the size of muscles is no indication of their importance, but only of the resistance to be overcome by their action; and that the more delicate actions are performed universally in the body by very small muscles, of which the iris in the eye furnishes a very conspicuous example.

Before the mode in which the radiated muscle adapts the *membrana tympani* to different sounds can be explained, it is necessary that the more important parts of the organ should be enumerated, and the use commonly assigned to each of them pointed out.

In man and the more perfect quadrupeds, this organ consists of the following parts: the *membrana tympani*, situated between the external passage and the cavity of the tympanum; four small bones, which form a chain across the tympanum,

connecting the membrana tympani with another membrane lining the foramen ovale, which opens into the vestibulum, a more internal part of the organ of hearing.

The bones are, the malleus, which is united to the membrana tympani by a portion of its handle, and to the second bone or incus by its head. The incus, which is connected to the malleus by a capsular ligament, forming a regular joint, the surfaces of the bones being covered with cartilage, but they have only a tremulous motion on one another. The incus is also attached to the side of the cavity of the tympanum, where the mastoid cells open, by a ligament on which it moves backwards and forwards: it is united by its long process to the orbicular bone, which is the smallest in the body, and connects the incus to the fourth bone or stapes, which has its base applied to the foramen ovale, or opening leading into the cavity of the vestibulum.

The cavity of the tympanum, in which these bones are situated, communicates with the external air by means of the Eustachian tube, so that there is always air behind the membrana tympani.

The malleus has three muscles, by which it is moved; one of them is called the tensor, from its pulling the malleus inwards, and tightening the membrana tympani: the other two act in an opposite direction, and relax the membrane; the largest of these is called the obliquus, and is the antagonist of the tensor muscle; the other is very small, and is called the laxator.

The stapes has one muscle, which acts upon it by bringing its basis closer to the foramen ovale.

The vestibulum, which is completely separated from the tympanum, by the membrane that lines the foramen ovale, com-

municates freely with the cochlea and semicircular canals ; but these cavities are filled with a watery liquor, and have no communication (as the tympanum has) with the external air.

This fact was ascertained in the horse, by the following experiment, repeated several times. The organ of hearing was separated from the skull immediately after death, and the cavity of the tympanum exposed ; the parts were then immersed in water, and the stapes removed ; by which means, the membrane of the foramen ovale was destroyed, but no globule of air was seen to escape through the water.\*

The following uses have generally been assigned to the parts now mentioned.

The membrana tympani was supposed to be adapted to receive impressions, by the combined action of the tensor and laxator muscles varying the degree of its tension, so as to bring it in unison with different sounds : these impressions were conducted, by the chain of bones, to the vestibulum, cochlea, and semicircular canals ; in which cavities, particularly the cochlea, they were supposed to undergo some modification, before they were impressed upon the nerves spread upon the linings of these cavities.

The function of modifying impressions of sound was assigned to the cochlea, partly from the delicacy of its internal structure, supposed to resemble a musical instrument, and partly from there being no other part of the organ apparently suited for repeating the variety of delicate sounds which pass into the ear : the changes that could be produced upon the membrana

\* This experiment was made by Mr. CLIFT, who superintends Mr. HUNTER's collection, and who has afforded me material assistance in the different parts of this investigation.

tympani by the muscles of the malleus, being considered as incapable of answering that purpose.

This slight sketch of the organ of hearing, and of the uses, as they are generally understood, of the different parts, will enable me to point out, with more clearness, what parts of the theory appear defective, and what improvements may be made on it.

It is true that the membrana tympani is stretched and relaxed by the action of the muscles of the malleus, but not for the purpose alleged in the commonly received theory. It is stretched, in order to bring the radiated muscle of the membrane itself into a state capable of acting, and of giving those different degrees of tension to the membrane which empower it to correspond with the variety of external tremors: when the membrane is relaxed, the radiated muscle cannot act with any effect, and external tremors make less accurate impressions.

The membrana tympani, with its tensor and radiated muscles, may be not unaptly compared to a monochord, of which the membrana tympani is the string; the tensor muscle the screw, giving the necessary tension to make the string perform its proper scale of vibrations; and the radiated muscle acting upon the membrane like the moveable bridge of the monochord, adjusting it to the vibrations required to be produced. The combined effects of the action of these muscles give the perceptions of grave and acute tones; and, in proportion as their original conformation is more or less perfect, so will their actions be, and, consequently, the perceptions of sound which they communicate.

This mode of subdividing the motions of the membrana tympani between two sets of muscles, allotting a portion to

each, is not peculiar to this part. A remarkable instance of it appears in the rapid movements of the fingers, in performing several actions, and particularly in playing on a musical instrument. In all such rapid motions, the fingers are bent to a certain degree by the long muscles that lie upon the fore-arm, to the tendons of which a set of smaller muscles are attached, called *lumbricales*. These last are unable to produce any effect on the fingers, till elongated in consequence of the action of the long muscles in bending the other joints; the *lumbricales* then become capable of bending the fingers a little more, and of acting with great rapidity. It is a curious circumstance, that a similar application of muscles should be employed to fit the fingers to produce a quick succession of sounds, and to enable the ear to be impressed by them.

From the explanation given of the adjustment of the *membrana tympani*, the difference between a musical ear and one which is too imperfect to distinguish the different notes in music, will appear to arise entirely from the greater or less nicety with which the muscle of the malleus renders the membrane capable of being truly adjusted. If the tension be perfect, all the variations produced by the action of the radiated muscle will be equally correct, and the ear truly musical; but, if the first adjustment is imperfect, although the actions of the radiated muscle may still produce infinite variations, none of them will be correct: the effect, in this respect, will be similar to that produced by playing upon a musical instrument which is not in tune. The hearing of articulate sounds requires less nicety in the adjustment, than of inarticulate or musical ones: an ear may therefore be able to perceive the one, although it is not fitted to receive distinct perceptions from the other.

The nicety or correctness of a musical ear being the result of muscular action, renders it, in part, an acquirement; for, although the original formation of these muscles in some ears renders them more capable of arriving at this perfection in their action, early cultivation is still necessary for that purpose; and it is found that an ear, which upon the first trials seemed unfit to receive accurate perceptions of sounds, shall, by early and constant application, be rendered tolerably correct, but never can attain excellence. There are organs of hearing in which the parts are so nicely adjusted to one another, as to render them capable of a degree of correctness in hearing sounds which appears preternatural.

Children who during their infancy are much in the society of musical performers, will be naturally induced to attend more to inarticulate sounds than articulate ones, and by these means acquire a correct ear, which, after listening for two or three years to articulate sounds only, would have been attained with more difficulty.

This mode of adapting the ear to different sounds, appears to be one of the most beautiful applications of muscles in the body; the mechanism is so simple, and the variety of effects so great.

Several ways in which the correctness of hearing is affected by the wrong actions of the muscles of the tympanum, that appeared to be inexplicable, can be readily accounted for, now that the means by which the membrane adjusts itself are understood. The following are instances of this kind.

CASE 1. A gentleman thirty-three years of age, who possessed a very correct ear, so as to be capable of singing in concert, though he had never learned music, was suddenly seized with a

giddiness in the head, and a slight degree of numbness in the right side and arm. These feelings went off in a few hours, but on the third day returned, and for several weeks he had returns of the same sensations. It was soon discovered that he had lost his musical ear; he could neither sing a note in tune, nor in the smallest degree perceive harmony in the performance of others. For some time he himself thought he had become a little deaf, but his medical attendant was not sensible of that in conversation. Upon going into the country, he derived great benefit from exercise and sea-bathing.

Twenty months after the first attack, he was capable of singing a Scotch air with tolerable exactness, though he could not sing in concert. He continued to improve in his health, and in the course of two or three years completely recovered his ear for music.

In this case, there appeared to be some affection of the brain, which had diminished the actions of the tensor muscles of the membranæ tympani, through the medium of the nerves which regulate their actions; this gradually went off, and the muscles recovered their former action.

CASE 2. A young lady was seized with a frenzy which lasted for several years. Previous to her derangement, she was incapable of singing in tune, from the want of an ear for music; but in the course of her madness she frequently, to the astonishment of her relations, sung a tune with tolerable correctness.

This case is the reverse of the former; and, as it arose from a directly contrary affection of the brain, may be considered as the result of an unusual degree of action in the tensor muscles, giving the membrane a more correct adjustment than it had before.

CASE 3. An eminent music master, after catching cold, found a confusion of sounds in his ears. Upon strict attention, he discovered that the pitch of one ear was half a note lower than that of the other; and that the perception of a simple sound did not reach both ears at the same instant, but seemed as two distinct sounds, following each other in quick succession, the last being the lowest and weakest. This complaint distressed him for a long time, but he recovered from it without any medical aid.

In this case, the whole defect appears to have been in the action of the radiated muscle, exerted neither with the same quickness nor force in one ear as in the other, so that the sound was half a note too low, as well as later in being impressed upon the organ.

This affection of the muscle of the membrana tympani is very similar to an affection of the straight muscles of one of the eyes, producing double vision, which I have noticed in a former lecture, when treating of the wrong actions of that organ.\*

In endeavouring to explain the uses of the more internal parts of the ear, considerable advantage may be derived from classing them in two divisions; namely, those which are formed for the purpose of receiving impressions conveyed through the medium of liquid or of solid substances; and those adapted to receive impressions made by the impulses of an elastic fluid, as the common air.

This can be done very correctly. Fish, which are formed to hear in water, can have only the parts belonging to the first division; while all the parts found in the ears of birds and

\* Vide Philosophical Transactions for the year 1797.

quadrupeds, that are not met with in fish, must belong to the second.

In fish, the organ consists of a vestibulum and three semicircular canals, and these are met with in all fish. In some genera there is an external opening, and substances of a hard nature are found lying loose in the vestibulum: these, however, cannot be considered as essential parts of the organ, from their not being common to fish in general.

Birds have the vestibulum and semicircular canals in common with fish, but they have also a *membrana tympani*; a slender bone connecting that membrane with the vestibulum; and an Eustachian tube. In birds, the *membrana tympani* is convex externally, being pushed forwards by the end of the slender bone abovementioned.

In quadrupeds and man, besides the vestibulum and canals met with in fish, the *membrana tympani*, the bone connecting it with the vestibulum, and the Eustachian tube, found in birds, there is a cochlea. The *membrana tympani* is either flat or concave externally; the bony connection between it and the vestibulum is made up of several bones, supplied with muscles to move them in different directions.

The parts which compose the organ of hearing in fish, must be intended for receiving impressions conveyed through water: those additional parts met with in birds, and the still greater additions which are found in the quadruped and man, must be intended by nature for rendering more perfect the impressions conveyed to the ear through the medium of the external air.

Fish, from the structure of the organ, can only hear sounds which agitate the water immediately in contact with the head of the fish; so that the impulse is conveyed, without inter-

ruption, from the liquid in which they live, to the organ of hearing.

Man is capable of hearing in a similar manner to fishes, when a communication of solid parts is kept up between the sounding body and the bones of the skull: experiments of this kind must have been made by many members of this learned Society.

One of the most common is, applying a watch to the forehead, and stopping the ears, which does not prevent the ticking from being heard: the sound is still more distinct when the watch is applied to the mastoid process. Here, as the sound can neither pass through the meatus externus, nor by the Eustachian tube, while the mouth is kept shut, it evidently must be conducted through the bones of the skull.

When the sound produced by boiling water is brought to the ear, by one end of an iron rod resting upon the side of the kettle and the other kept in contact with the teeth, the sound is conducted in the same way, although in this case it has by some been supposed to pass through the Eustachian tube.

In this mode of hearing, the vestibulum and semicircular canals are probably the only parts of the organ which are necessary to convey the impression to the expansion of the auditory nerve.

In hearing in air, the use of the membrana tympani in man and quadrupeds has already been explained. Its office in birds is precisely the same; but as in birds this membrane has no tensor muscle to vary its adjustment, but is always kept tense by the pressure of the end of the slender bone, the scale in birds cannot descend so low as in the human ear; and the intervals in their scale will be more minute, in consequence of the slightest tremor communicated by the action of the radiated

muscle to one end of the slender bone being immediately conducted to the internal organ ; while in the human ear it has to pass from one bone to another, before it arrives at the vestibulum.

The cochlea has been considered by all physiologists as one of the most intricate and curious parts of the ear, and on that account had a most important office assigned to it. This, however, is now to be transferred to the *membrana tympani* ; and, upon attentive consideration of the subject, it will appear impossible for the cochlea to be of any use in modulating sounds, since the ear is only intended to convey impressions received from external bodies ; hence, no impression can be communicated to the cochlea, which has not been transmitted by the *membrana tympani*. But, if all the varieties of sound are repeated by the *membrana tympani*, no modulation in the cochlea is required ; and, when it is considered that the cochlea contains water, instead of air, the effect upon every part will be found to be simultaneous.

That the cochlea is neither absolutely necessary to fit the organ to be impressed by sounds communicated through air, nor to render it what is termed a musical ear, is sufficiently proved by that part being wanting in birds, whose organ is particularly adapted to inarticulate sounds. Some birds, particularly bulfinches, can be taught to sing various airs, although it will be always in high notes.

If it should be found that birds hear less accurately than quadrupeds, it will favour the idea that the great delicacy of structure of the cochlea, is intended to render the nerves which are spread upon it more readily impressed by weak tremors, than those in either the vestibulum or semicircular canals.

The cochlea and semicircular canals must be considered as two of the most important parts of the ear ; their peculiar forms are no doubt adapted to some essential purposes ; but, what are the precise advantages derived from their particular shape, is at present unknown. There is, however, much ground to believe, that a more extensive knowledge in comparative anatomy, joined with future observations, may clear up this very curious and obscure part of the physiology of the organ of hearing.

In the elephant, the small bones, the cochlea, and semicircular canals, are larger than those in the human ear, nearly in the same proportion with the increased size of the *membrana tympani*. In that animal, there is a very remarkable peculiarity ; which is, a cellular structure occupying the upper and posterior part of the skull, inclosed between the two tables, communicating by a considerable aperture with the cavity of the *tympanum*, and lined by a similar membrane : the cells communicate freely with one another at their lower extremities, but not near the upper, forming irregular cylinders, placed in a converging direction, towards the cavity of the *tympanum*.

There is no middle bony septum, separating the cells of the skull belonging to one ear from those which open into the other, but a ready communication between them.

On the anterior part of the skull there is also a similar cellular structure, only much smaller, which communicates with the nose, but is entirely separate and distinct from that which forms an appendage to the organ of hearing.

That the elephant hears better than other animals, is generally asserted by those who have had opportunities of making observations on the subject. As this opinion has been advanced by men who had no knowledge in anatomy, and had

no previous theory to bias their judgment, it is deserving of credit. The organ of hearing being now found more perfect, and formed upon a larger scale than in any other animal with which we are acquainted, considerable weight is given to this opinion.

Mr. CORSE, who resided many years at Tiperah, in Bengal, and paid particular attention to the manners and habits of elephants, concurs in the belief of their hearing being more acute than that of man. The following circumstances are mentioned by him in proof of it.

A tame elephant, who was never reconciled to have a horse moving behind him, although he expressed no uneasiness if the horse was within his view, either before or on one side, could distinguish the sound of a horse's foot at a distance, some time before any person in company heard it: this was known by his pricking up his ears, quickening his pace, and turning his head from side to side.

A tame female elephant, who had a young one, was occasionally sent out with other elephants for food, without the young one being allowed to follow. She was not in the habit of pining after her young one, unless she heard its voice; but frequently, on the road home, when no one could distinguish any sound whatever, she pricked up her ears, and made a noise expressive of having heard the call of her young. This having occurred frequently, attracted Mr. CORSE's notice, and made him, at the time the female elephant used these expressions, stop the party, and desire the gentlemen to listen; but they were unable to hear any thing till they had approached nearer to the place where the young one was kept.

The foregoing observations, the object of which has been to

prove that the membrana tympani of the ear has a muscular structure, have already exceeded the limits of a lecture, which prevents us from going further at present into the consideration of this very curious and important organ. The general analogy between the uses of its different parts and those of the organ of vision, and the similar variations of their actions when under the influence of disease, furnish materials which, on some future occasion, may be laid before this learned Society.